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Abstract

Choice of most suitable radiation characteristics for any given gauging-problem (Session F)

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Gauging mostly aims at detection or measurement of mass differences, rather than at determination of an average mass as such. In this respect level indication may be considered as a gauging problem as well, in addition to thickness- or density (difference!) measurements.

The problem can be simply presented as follows. A mass deviation ΔD from average mass D must be detected or measured by means of a signal difference ΔS significally larger than possible statistical signal fluctuations. This aim must be achieved in a given maximum time interval t. The available tools are isotope sources of different radiation characteristics such as mass attenuation coefficient and source strength.

When secondary effects as heterogeneity of radiation, scattering, source dimensions, detector response etc. are neglected, β- as well as γ-radiation can in first approximation be supposed to obey the same exponential absorption law. Simple theoretical considerations then show that the average object mass alone determines the choice of the optimum radio-isotope (c.q. mass attenuation coefficient of principal radiation). In consequence, the required source strength depends on

1. minimum mass difference to be detected (ΔD);
2. accuracy wanted ($\Delta S/\sqrt{S_D}$);
3. minimum measuring time t;
4. geometry and detector efficiency.

When signals are defined as total count = count rate x measuring time, formulae can be derived to show the intercorrelation of all important variables

and parameters in case the optimum radiation can be chosen. Moreover, a nomogram has been constructed to display the situation for optimum as well as for non-optimum conditions.

Experimental data show to which extent the simplified assumptions are valid. They justify the trial to consider all mass-difference measurements by means of high-energy radiation as a general problem, which can, in spite of the large variation in objective, always be approached in essentially the same way.